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No. 198

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PEOPLE'S REPUBLIC OF CHINA

ABSTRACTS

ARMORED TANK'S SUSPENSION SYSTEM PARAMETERS IDENTIFIED

Harbin DIZEN GONGCHENG YU GONGCHENG ZHENDONG [EARTHQUAKE ENGINEERING AND ENGINEERING VIBRATION] in Chinese No 4, 1983 pp 68-81

[Article by Shang Jiuquan [1424 0036 6898], Fu Zhengxin [0265 2973 1800], and Xi Jingzhu [1598 7234 3796] of the Engineering Mechanics Institute of the Chinese Academy of Sciences: "Identification of Parameters of the Suspension System of a Tank"]

[Text] Abstract

This article determines the coefficients of rigidity and damping of a suspension system, using mathematical models based on results of testing the characteristics of the spontaneous vibration of a tank. It also gives the value of the rigidity coefficient of the rubber on the rim of the load-bearing wheel and the damper.

I. Foreword

The tank is a complex vehicle with tracks. The suspension system, consisting of several torsion axles, dampers, and balancing toggles, is supported by the load-bearing wheels, and the load-bearing wheels are in contact with the tracks via rubber wheel rims. When the tank is simplified as a system with many degrees of freedom and is subjected to dynamic reaction analysis, we must first understand the parameters of the suspension system. Ordinarily, these parameters are the equivalent spring rigidity coefficient k_{eq} beyond the torsional rigidity of the torsion axle and the viscous damping coefficient of the damper. Sometimes they also include the rigidity coefficient of the wheel rim rubber and the damping coefficient. Our test results show that we should also consider the effect of the rigidity coefficient k_o of the damper itself.

The parameters of the suspension system can be determined beforehand by various experimental methods. But when the torsion axle, the damper, and such parts are installed on the tank to form a whole, the situation changes. For example, in the course of vibration, the effect of such factors as the tracks and dry friction is difficult to estimate beforehand. We used the measured results of spontaneous vibrations of a certain model of tank to identify the parameters of the suspension system through the establishment of mathematical models while considering the effects of the above factors, and we derived

numerical results. The calculated results using different mathematical models show this method is simple and feasible and has a definite reliability.

II. Test Results

1. Sudden Release Method

As illustrated in Figure 1, three wooden poles of equal length evenly supported the body of a certain tank about 6 centimeters away from the stationary balanced position. Then, the pulling vehicle pulled the steel wire that was wrapped around three wooden poles. The wooden poles fell almost simultaneously, causing the tank suddenly to drop evenly. The time curve of displacement of freely attenuating vibration produced was recorded by the testing device shown in Figure 2 and illustrated in Figure 3. The curves 1, 2, 3 were respectively measured on top of the upper lid of the fan gearbox of the tank, the point of projection of the center of gravity of the body of the tank on the bottom deck, and the front end of the deck of the cockpit. We regarded the mass of suspension of the tank as a rigid body and the time curve 2 in Figure 3 as the time curve of freely attenuated displacement of the center of gravity of a rigid body when the tank underwent vertical vibration. The average frequency was $\bar{f}_{d2} = 2.2$ hertz. We utilized formula (1)

$$\ln(x_n/x_{n+1}) = \frac{2\pi\zeta}{\sqrt{1-\zeta^2}} \tag{1}$$

to find the critical damping ratio ζ of equivalent viscous damping.[1] Because the damping was large, the amplitude of the waveform attenuated to nearly zero only after four and a half waves. To reduce the error in calculating the value of ζ from the time curve 2 of displacement, we solved for the value of ζ under three different situations, and then we took their average value $\bar{\zeta}$ as the final result:

(1) From Figure 4 we obtain

$$\ln(x_n/x_{n+1}) = \ln(17.5/3.5) = \frac{2\pi\zeta}{\sqrt{1-\zeta^2}}$$

$$\zeta_1 = 0.248$$

(2) From Figure 5 we obtain

$$\left| x_n/x_{n+\frac{1}{2}} \right| = \left| \frac{-x_c e^{\frac{-\zeta}{\sqrt{1-\zeta^2}}\omega_d t}}{x_c e^{\frac{-\zeta}{\sqrt{1-\zeta^2}}\omega_d (t+T_d/2)}} \right| = e^{\frac{\zeta\pi}{\sqrt{1-\zeta^2}}}$$

and thus

$$\ln \left| x_n/x_{n+\frac{1}{2}} \right| = \frac{\zeta\pi}{\sqrt{1-\zeta^2}} \tag{2}$$

Let x_n = 17.5 centimeters and $x_n + \frac{1}{2}$ = 9.5 centimeters, and substitute them into the above equation. We obtain ζ_{ii} = 0.182.

(3) If we revise the startup value of the time curve 2 of displacement as measured by the pendulum displacement sensor (the line with dots -•-•- in Figure 5), then

$$\ln(33.3/9.5) = \frac{2\pi\zeta}{\sqrt{1-\zeta^2}}$$

$$\zeta_{iii} = 0.1958$$

Finally, we obtain the average value $\bar{\zeta} = (\zeta_i + \zeta_{ii} + \zeta_{iii})/3 = 0.2085$.

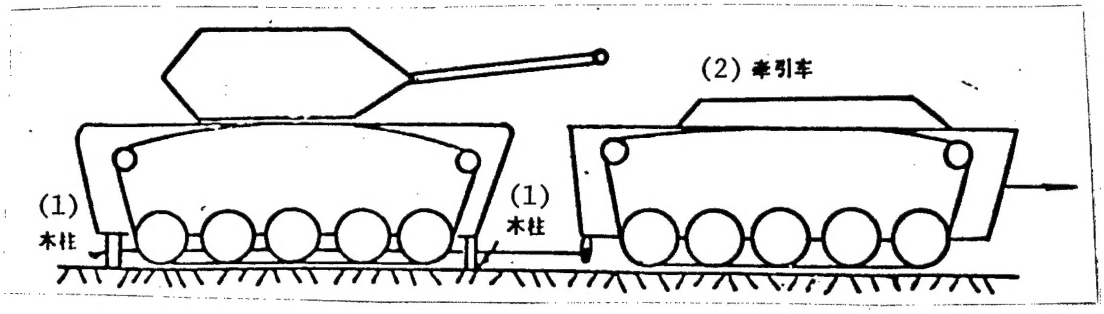

Figure 1

Key: (1) Wooden pole (2) Pulling vehicle

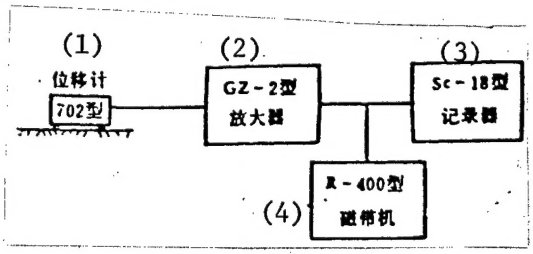

Figure 2. Displacement Measuring System

Key: (1) Displacement meter
(2) Model GZ-2 amplifier
(3) Model Sc-18 recorder
(4) Model R-400 magnetic tape drive

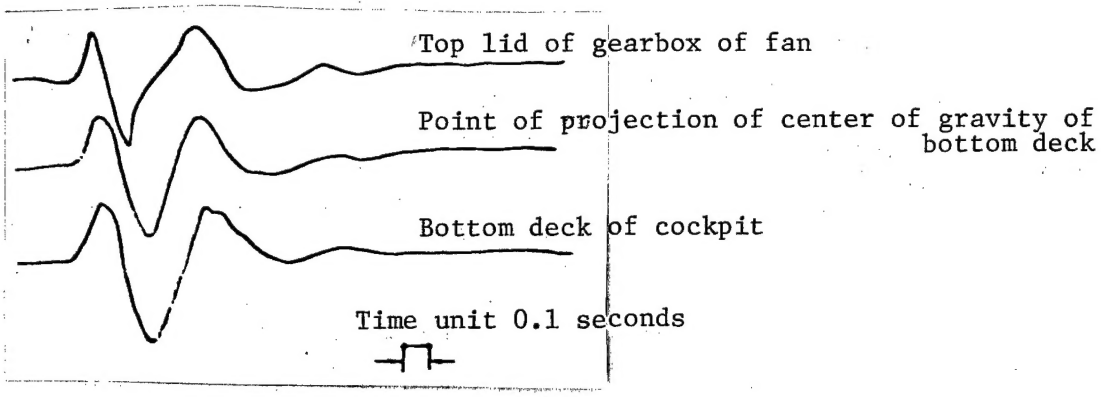

Figure 3. Time Curve of Displacement of Sudden Release Shock

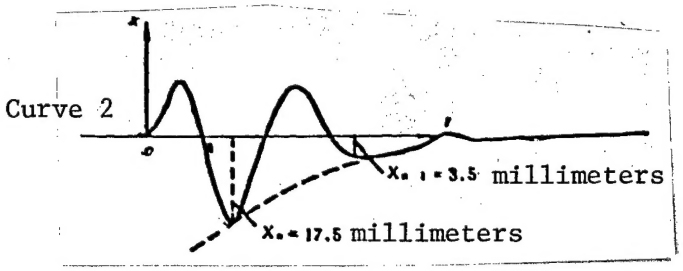

Figure 4

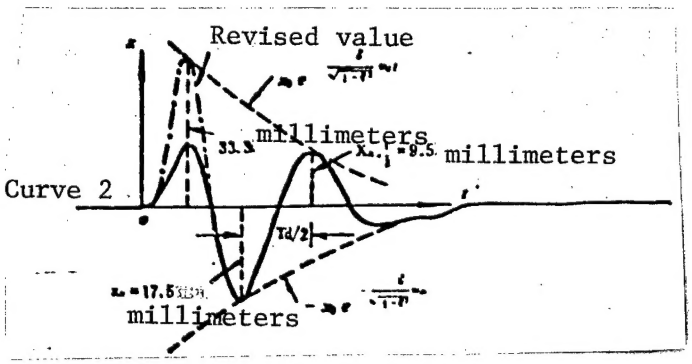

Figure 5

2. Rocket Tube Shock Method[2]

Two rocket tubes are symmetrically placed on top of the turret of a tank. The combined force f the shock produced when they are simultaneously detonated passes through the center of rigidity of the body of the vehicle (we can approximately consider that the center of rigidity of that tank and the center of gravity coincide); see Figure 6. This shock creates only a vertical vibration in the body of the vehicle and does not cause pitching or left-and-right rolling. Besides replacing the Model 702 large displacement meter with the Model 701 small displacement meter, other testing devices and test points are the same as those in the previous test. Figure 7 illustrates one set of the five test results. We obtained $\bar{f}_d$ = 7.2 hertz, ζ = 0.0687 from the five sets of test curves, and the value of $\bar{f}_d$ was entirely the same as the result obtained by analysis 3348 using the real-time narrow-band analyzer[3] (See Figure 8).

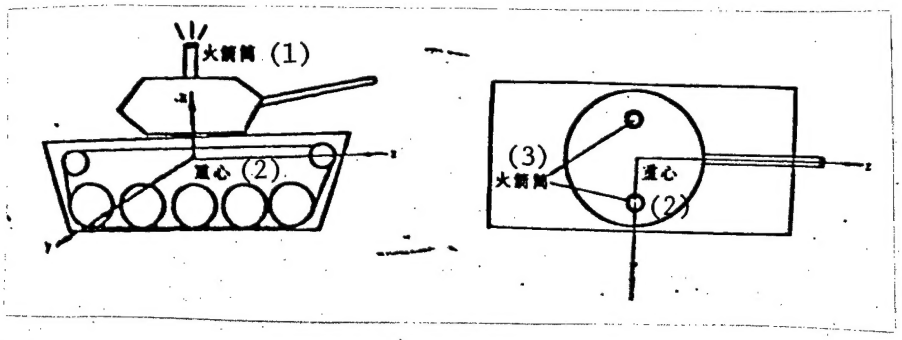

Figure 6. Illustration of Rocket Tube Shock

Key: (1) Rocket tube
(2) Center of gravity
(3) Rocket tubes

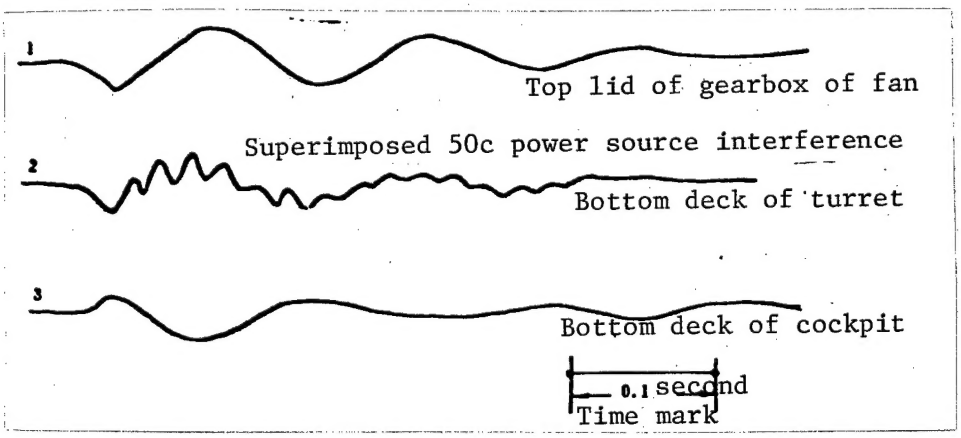

Figure 7. Displacement Curve of Rocket Shock

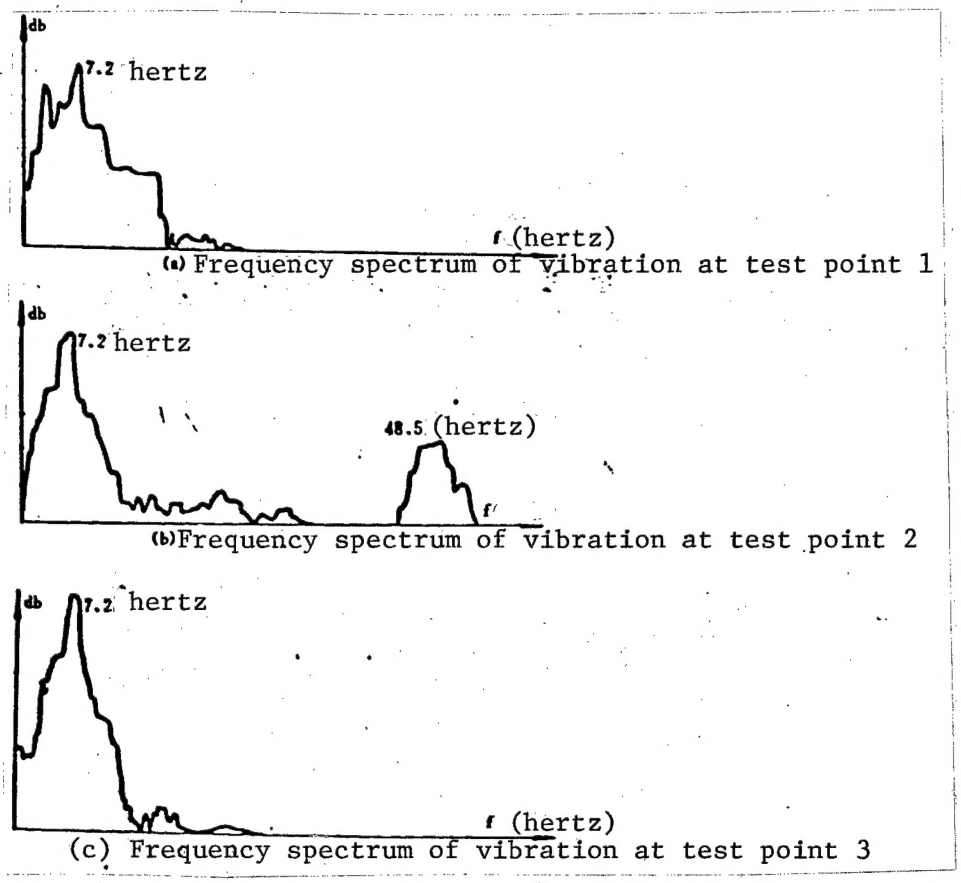

Figure 8. Diagram of Frequency Spectrum of Vibration of Tank in Rocket Tube Shock Test

III. Identification of the Parameters of the Suspension System

1. Joint Pitching-Vertical Vibration

The tank is supported by three even wooden props. After the sudden drop, the free vibration produced by the body of the vehicle will include vertical vibration, pitching, and left-and-right rolling. When the initial displacement $X_o < M_{suspension}/k$ total the load-bearing wheel will never leave the ground surface during the course of vibration. At this time, the tank can be simplified as in Figure 9.

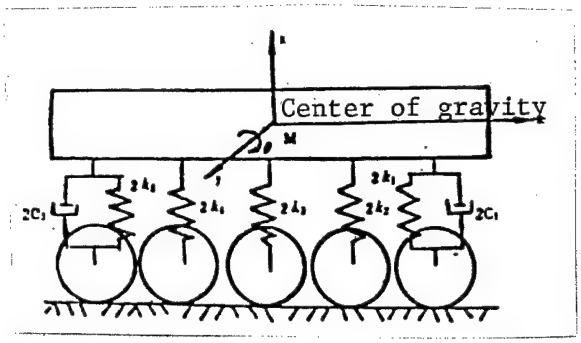

Figure 9

If we do not consider rolling of the body of the vehicle about the Z axis (the testing ground surface is flat and hard), the equation for the free and joint pitching-vertical vibration[4] is

$$\begin{cases} M\ddot{x}+\mu_1\dot{x}+K_1x=-K_2\theta-\mu_2\dot{\theta} \\ I_{yy}\ddot{\theta}+\mu_4\dot{\theta}+K_4\theta=-K_3x-\mu_3\dot{x} \end{cases} \tag{3}$$

Where

$$K_1=\sum_{i=1}^{n}2k_i,\quad K_2=K_3=\sum_{i=1}^{n}2k_iZ_i,\quad K_4=\sum_{i=1}^{n}2k_iZ_i^2,$$

$$\mu_1=\sum_{i=1}^{n}2c_i,\quad \mu_2=\mu_3=\sum_{i=1}^{n}2c_iZ_i,\quad \mu_4=\sum_{i=1}^{n}2c_iZ_i^2$$

n --half of the sum of the number of load-bearing wheels;
k_i, c_i --rigidity and damping coefficients corresponding to the ith load-bearing wheel;
I_{yy} --the rotary inertia of the body of the vehicle about the y axis;
M --mass of suspension of the tank;
θ --turning angle of the body of the vehicle about the y axis.
Z_i --horizontal distance from the center of gravity of the vehicle to the ith load-bearing wheel.

After rearrangement equations (3) can be written as

$$\begin{cases} M\ddot{x}+(\mu_1\dot{x}+\mu_2\dot{\theta})+(K_1x+K_2\theta)=0 \\ I_{yy}\ddot{\theta}+(\mu_3\dot{x}+\mu_4\dot{\theta})+(K_3x+K_4\theta)=0 \end{cases} \tag{4}$$

Rewriting them as a matrix

$$[M]\{\ddot{U}\}+[C]\{\dot{U}\}+[K]\{U\}=0 \tag{5}$$

where

$$[M]=\begin{bmatrix} M & 0 \\ 0 & I_{yy} \end{bmatrix}, \quad [C]=\begin{bmatrix} \mu_1 & \mu_2 \\ \mu_3 & \mu_4 \end{bmatrix}$$

$$[K]=\begin{bmatrix} K_1 & K_2 \\ K_3 & K_4 \end{bmatrix}, \{U\}=\begin{Bmatrix} x \\ \theta \end{Bmatrix}$$

Let the solution to equation (5) be

$$\{U\}=\{\Phi\}e^{pt} \tag{6}$$

where p is a complex number that takes the following form

$$p=-\omega\zeta+j\omega\sqrt{1-\zeta^2}$$

Substitute p into equation (5) and obtain

$$(p^2[M]+p[C]+[K])\{\Phi\}=0 \tag{7}$$

But

$$|p^2[M]+p[C]+[K]|=0 \tag{8}$$

Expanding equation (8)

$$\begin{vmatrix} p^2M+p\mu_1+K_1 & p\mu_2+K_2 \\ p\mu_3+K_3 & p^2I_{yy}+p\mu_4+K_4 \end{vmatrix}=0 \tag{9}$$

Finally, we obtain

$$p^4+H_1p^3+H_2p^2+H_3p+H_4=0 \tag{10}$$

where

$$\begin{cases} H_1=(\mu_1I_{yy}+\mu_4M)/MI_{yy} \\ H_2=(K_1I_{yy}+K_4M+\mu_1\mu_4-\mu_2\mu_3)/MI_{yy} \\ H_3=(K_1\mu_4-K_2\mu_3-K_3\mu_2+K_4\mu_1)/MI_{yy} \\ H_4=(K_1K_4-K_2K_3)/MI_{yy} \end{cases} \tag{11}$$

If the rigidity and the damping coefficients of the suspension corresponding to each load-bearing wheel are even and are represented by k and c, then after we calculate equation (11) by substituting the related parameters of the tank into that equation,

$$\begin{cases} H_1 = 2.14354 \times 10^{-3} c \\ H_2 = 4.208477 \times 10^{-3} k + 1.095842 \times 10^{-6} c^2 \\ H_3 = 3.214783 \times 10^{-6} kc \\ H_4 = 3.214783 \times 16^{-6} k^2 \end{cases} \tag{12}$$

where the units of k and c are kilogram/meter and kilogram•second/meter respectively. We note that

$$\begin{cases} p_i = -\omega_i \zeta_i + j\omega_i \sqrt{1-\zeta_i^2} = -\rho_i + j\Omega_i \\ p_i^2 = (\rho_i^2 - \Omega_i^2) - j2\rho_i\Omega_i = A_i - jB_i \\ p_i^3 = (B_i\Omega_i - \rho_i A_i) + j(\rho_i B_i + A_i\Omega_i) = F_i + jE_i \\ p_i^4 = (A_i^2 - B_i^2) - i2A_iB_i \end{cases} \tag{13}$$

where

$j = \sqrt{-1}$

ω_i --the angular frequency of the ith type vibration without damping;

ζ_i --critical damping ratio of the ith type vibration;

Ω_i --original angular frequency of the ith type vibration with damping.

Substituting equation (13) into equation (10), we obtain

$$\left[(A_i^2 - B_i^2) + H_1F_i + H_2A_i - H_3\rho_i + H_4\right] + j(H_1E_i - H_2B_i + H_3\Omega_i - 2A_iB_i) = 0 \tag{14}$$

If we let $\zeta_i = 0$, then the equation of the frequency without damping can be obtained from equation (14) by letting the real term equal zero[5]

$$\omega_i^4 - H_2\omega_i^2 + H_4 = 0 \tag{15}$$

We regard the time curve 2 of displacement at the center of gravity in Figure 3 as the free attenuation curve of vertical vibration of the joint pitching-vertical vibration of the tank.

According to $\bar{f}_{d2} = 2.2$ hertz and $\zeta = 0.2085$, we know that the original angular frequency without damping $\omega_2 = 14.13$ (radians/second). From equation (12) we obtain

$$\begin{cases} H_2 = 4.208477 \times 10^{-3} k \\ H_4 = 3.214783 \times 10^{-6} k^2 \end{cases}$$

Substituting the above and the value of ω_2 into equation (15), we solve the rigidity coefficient of the suspension system

$$k = 6.2316 \times 10^4 \quad \text{(kilograms/meter)}$$

This value is 19 percent higher than the known equivalent rigidity coefficient $k_{eq} = 5.25 \times 10^4$ (kilograms/meter). This is because it contains the effects of tension of the track, dry friction, and the rigidity coefficient k_o of the damper.

Substituting the value of k identified above into equation (15), it is not difficult to obtain the angular frequency of pitching vibration $\omega_1 = 7.9$ (radians/second). If we substitute the value of ω_2 and the corresponding values of ρ_2, Ω_2, A_2, B_2, F_2, E_2 in equation (13) into equation (14), and note the value of k that has been identified, then

$$(-8.719790 \times 10^3 + 2.825849c - 1.998731 \times 10^{-4}c^2) + j(8.353476 \times 10^3 - 1.419239c - 8.927973 \times 10^{-5}c^2) = 0 \tag{16}$$

If we let the modulus in the above equation equal zero, then we can obtain the equivalent equation

$$c^4 - 1.828467 \times 10^4 c^3 + 2.50286 \times 10^8 c^2 - 1.523218 \times 10^{12} c + 3.042882 \times 10^{15} = 0 \tag{17}$$

Solving equation (17), we obtain the viscous damping coefficient of the suspension system

$$c = 4.57 \times 10^3 \quad \text{(kilogram·second/meter)}$$

In the following, we will determine the critical damping ratio ζ_1 of the pitching vibration according to the values of k and c previously identified and the original angular frequency Ω_1 with damping. By substituting $p_1 = \rho_1 + j\Omega_1$ into equation (10) and let the imaginary part be zero, we have

$$-4\rho_1^3 + 3H_1\rho_1^2 + \rho_1(4\Omega_1^2 - 2H_2) + (H_3 - H_1\Omega_1^2) = 0 \tag{18}$$

We note that $\rho_1 = \omega_1\zeta_1$ and $\Omega_1^2 = \omega_1^2 (1-\zeta_1^2)$; thus the above equation becomes

$$\zeta_1^3 - 0.619474\zeta_1^2 + 0.640676\zeta_1 - 0.135365 = 0 \tag{19}$$

From equation (10) we find the solution that is smaller than 1,

$$\zeta_1 = 0.25$$

Thus, the original frequency of the pitching vibration with damping

$$f_{d1}=\frac{\omega_1\sqrt{1-\zeta_1^2}}{2\pi}=1.22 \text{ hertz}$$

This value is close to the actually measured result of $\bar{f}_{d1} = 1.28$ hertz.[3]

2. Vertical Vibration

We can see from equation (3) of free joint pitching-vertical vibration that when

$$\begin{cases} K_2=K_3=\sum_{i=1}^{n} 2k_iZ_i=0 \\ \mu_2=\mu_3=\sum_{i=1}^{n} 2c_iZ_i=0 \end{cases} \tag{20}$$

are satisfied, i.e., when all load-bearing wheel positions are symmetric about the center of gravity of the body of the vehicle, the two equations in the set of equations (3) are mutually independent, and at the same time, using the sudden release method to produce shock, the tank does not roll and does not pitch. There is only vertical free attenuated vibration. Although the tank we tested did not strictly satisfy equation (20), when we neglect pitching vibrations and consider only vertical vibrations, and at the same time calculate the effects of the mass of the load-bearing wheels and the rubber around the wheel rim, the system can be approximately simplified to a problem of three degrees of freedom in the vertical direction. See Figure 10.

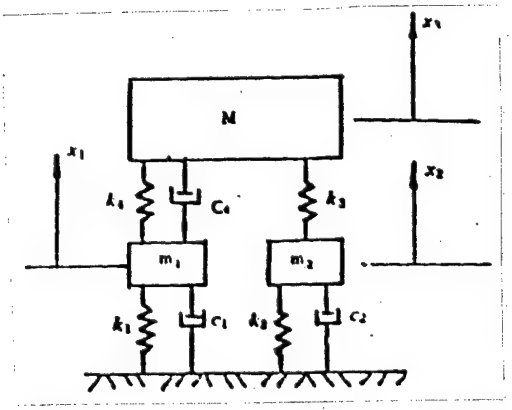

Figure 10. Illustration of Three Degrees of Freedom

We still used the matrix to express the equation of free vibration of the system shown in Figure 10.

$$[M]\{\ddot{x}\}+[C]\{\dot{x}\}+[K]\{x\}=0 \tag{21}$$

where

$$[M]=\begin{bmatrix} m_1 & 0 & 0 \\ 0 & m_2 & 0 \\ 0 & 0 & M \end{bmatrix}$$

$$[C]=\begin{bmatrix} c_1+C_4 & 0 & -C_4 \\ 0 & c_2 & 0 \\ -C_4 & 0 & C_4 \end{bmatrix}$$

$$[K]=\begin{bmatrix} k_1+k_4 & 0 & -k_4 \\ 0 & k_2+k_3 & -k_3 \\ -k_4 & -k_3 & k_3+k_4 \end{bmatrix}$$

m_1 --represents the sum of the mass of four load-bearing wheels with dampers;

m_2 --represents the sum of the mass of six load-bearing wheels with dampers;

M --suspended mass;

$k_1 = \frac{4}{10} K_{rubber}$, $k_2 = \frac{6}{10} K_{rubber}$;

K_{rubber} --sum of the rigidity coefficients of the rubber of 10 load-bearing wheel rims;

$k_3 = 6k$, $k_4 = 4k$,

k --rigidity coefficient of each spring of the suspension system.

$c_1 = \frac{4}{10} C_{rubber}$, $c_2 = \frac{6}{10} C_{rubber}$,

C_{rubber} --sum of the damping coefficients of the rubber of 10 load-bearing wheel rims;

$C_4 = 4c$

c --the damping coefficient of each damper.

Before identifying k and c, we must first utilize Figure 7 and Figure 8 to give us the experimental results of freely attenuating vibration of the shock produced by the rocket tube, and we must determine the total rigidity coefficient K_{rubber} of the rubber on 10 load-bearing wheel rims and the total damping coefficient C_{rubber}. Because the duration of the instantaneous striking force produced by the rocket shock generator and the thrust is small, the oil in the damper cannot leak out from the spout in time. This is equivalent to saying that the damper has an extremely large damping. Therefore, there is no relative movement between the suspended mass and the load-bearing wheel. They vibrate as a whole body and become a system with a single degree of freedom. This has already been proven by the experimental results shown in Figure 7 and Figure 8. The freely attenuating vibration produced by the shock from the rocket tube can be represented by the system illustrated in Figure 11. We know

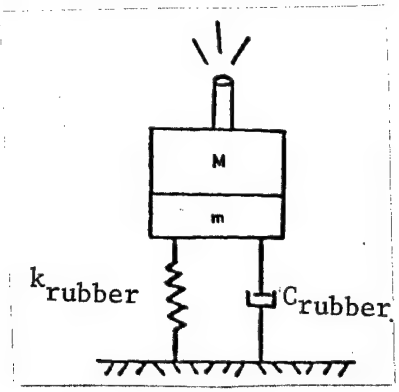

Figure 11

from $\bar{f}_d$ = 7.2 hertz and ζ = 0.0687 obtained from the rocket tube shock test that the original angular frequency without damping of that system is

$$\omega = 45.35 \text{ (radians/second); therefore}$$

$$K_{rubber} = (M + m)\omega^2 = 7.054715 \times 10^6 \text{ (kilogram/meter)}$$

$$C_{rubber} = 2\zeta\omega(M + m) = 2.1376 \times 10^4 \text{ (kilogram·second/meter)}$$

where $m = m_1 + m_2$. The K_{rubber}, C_{rubber} obtained from this are close to the simulated experimental results given in the appendix.

From equation (21) we can obtain an expression similar to equation (8)

$$|p^2[M]+p[C]+[K]| = \begin{vmatrix} p^2m_1+p(c_1+C_4)+(k_1+k_4) & 0 & -(pC_4+k_4) \\ 0 & p^2m_2+pc_2+(k_2+k_3) & -k_3 \\ -(pC_4+k_4) & -k_3 & p^2M+pC_4+(k_3+k_4) \end{vmatrix} = 0 \tag{22}$$

After expansion

$$p^6m_1m_2M+p^5A+p^4B+p^3G+p^2D+PE+F=0 \tag{23}$$

where

$$\begin{cases} A=4m_2(m_1+M)c+M(c_1m_2+c_2m_1) \\ B=\left[4m_2c_1+4c_2(m_1+M)\right]c+\left[6m_1M+m_2(10m_1+4M)\right]k \\ \quad +M(m_1k_2+m_2k+c_1c_2) \\ G=\left[4k_1m_2+4k_2(m_1+M)+4c_1c_2\right]c+k\left[10m_2c_1+6Mc+c_2(10m_1+4M)\right] \\ \quad +24kc(m_1+m_2+M) \\ D=4c(c_2k_1+c_1k_2)+24kc(c_1+c_2)+(10m_2k_1+10c_1c_2+10m_1k_2 \\ \quad +4Mk_2+6k_1M)k+24k^2(m_1+m_2+M) \\ E=4k_1k_2c+24kc(k_1+k_2)+10k(c_1k_2+c_2k_1)+24k^2(c_1+c_2) \\ F=10k_1k_2k+24k^2(k_1+k_2) \end{cases}$$

Substituting them into m_1, m_2, M, k_1, k_2, c_1 and c_2, we can find the above coefficients. If we take the time curve 2 of displacement in Figure 3 as the modular parameter of the first type of vibration, then from equation (23) we get

$$\begin{aligned} &(k^2+6.444908\times10^5k-2.981542kc-6.400284\times10^5c- \\ &4.163869\times10^{10})+j(k^2-5.538923\times10^5k+5.50573\times10^3kc \\ &+1.344265\times10^9c-9.034482\times10^{12})=0 \end{aligned} \tag{24}$$

If we let the real term and the imaginary term equal zero, then we have a set of binary quadric equations. By solving them, we obtain the parameters of the suspension system

$$\begin{cases} k = 6.4954 \times 10^4 & \text{(kilograms/meter)} \\ c = 5.329 \times 10^3 & \text{(kilograms}\cdot\text{second/meter)} \end{cases}$$

For convenience, we can also simplify the problem of three degrees of freedom illustrated in Figure 10 to a problem of two degrees of freedom illustrated in Figure 12. This will greatly reduce the amount of calculation. By repeating the calculation of the three degrees of freedom, we get

$$\begin{cases} S_1+4cS_2+10kS_3=0 \\ S_4+4cS_5+10kS_6=0 \end{cases} \tag{25}$$

where

$$\begin{cases} S_1=Mm(\rho_1^4-6\rho_1^2\Omega_1^2+\Omega_1^4)+MC_*\rho_1(3\Omega_1^2-\rho_1^2)+MK_*(\rho_1^2-\Omega_1^2) \\ S_2=\rho_1(M+m)(3\Omega_1^2-\rho_1^2)+(\rho_1^2-\Omega^2{}_1)C_*-\rho_1K_* \\ S_3=(M+m)(\rho^2{}_1-\Omega_1^2)-\rho_1C_*+K_* \\ S_4=-4Mm\rho_1\Omega_1(\rho_1^2-\Omega_1^2)+M\Omega_1(3\rho_1^2-\Omega_1^2)C_*-2M\rho_1\Omega_1K_* \\ S_5=\Omega_1(M+m)(3\rho_1^2-\Omega_1^2)-2\rho_1\Omega_1C_*+\Omega_1K_* \\ S_6=\Omega_1C_*-2(M+m)\rho_1\Omega_1 \end{cases} \qquad [*=\text{rubber}]$$

Solving equation (25) we obtain

$$k = 6.7096 \times 10^4 \quad \text{(kilograms/meter)}$$
$$c = 5.445 \times 10^3 \quad \text{(kilograms•second/meter)}$$

The difference between this result and the situation of three degrees of freedom is very small.

Using equation (7), we can solve the vector matrix [u] of the complex vibration of the system with two degrees of freedom. At this time, equation (7) becomes

$$\begin{bmatrix} p^2m+p(4c+C_{\text{轮}})+(10k+K_{\text{轮}}) & -(4pc+10k) \\ -(4pc+10k) & p^2M+4pc+10k \end{bmatrix} \begin{Bmatrix} \Phi_{1r} \\ \Phi_{2r} \end{Bmatrix} = \{0\} \quad (r=1,2) \tag{26}$$

where Φ_{1r} and Φ_{2r} respectively represent the amplitude of the rth type vibration of the mass m and M, while

$$\{u_r\} = \begin{Bmatrix} \Phi_{1r}/\Phi_{2r} \\ 1 \end{Bmatrix} \tag{27}$$

represents the column matrix of complex vectors of the rth type vibration. The elements of the matrix of equation (26) are all known; thus

$$[u] = \begin{bmatrix} 0.084 \pm j0.034 & -14.911 \pm j19.486 \\ 1 & 1 \end{bmatrix} \tag{28}$$

The results of [u] show that when the tank undergoes the first type of vibration, the displacement of the suspended mass M is much larger than the displacement of the load-bearing wheel, but when the tank undergoes the second type of vibration, the situation is exactly the opposite.

3. Estimating the Rigidity Coefficient k_e of the Damper

The three previous kinds of calculations show that the values of the rigidity coefficient k of the spring obtained by identification are all greater than the known equivalent rigidity coefficient $k_{eq} = 5.25 \times 10^4$ (kilograms/meter). This is because the omission of pitching vibration is equivalent to increasing the limiting conditions and thus increasing the value of k. More importantly, the tension of the track and the oil damper themselves also have rigidity. Referring to reference document[6] we can simplify the oil damper to become one of the models illustrated in Figure 13, where $N = k_0'/k_0$. We used model (a); thus, if we do not include the effect of the tension of the tracks and dry friction, we can revise the mathematical model of joint pitching-vertical vibration to become the form shown in Figure 14, and we can make a preliminary estimate of the rigidity coefficient k_0 of the damper. At this time, we must recalculate the coefficients in equation (10) and finally solve it to get the following:

$k_0 = 2.4368 \times 10^4$ (kilograms/meter)
$c = 4.57 \times 10^3$ (kilograms•second/meter)

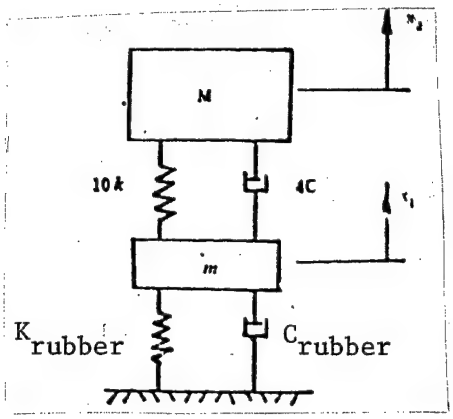

Figure 12. Illustration of Two Degrees of Freedom

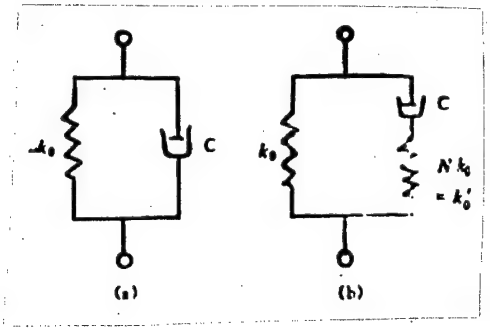

Figure 13. Model of the Oil Damper

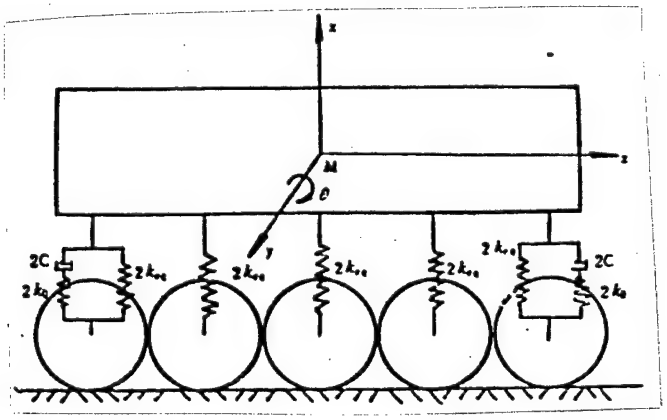

Figure 14

IV. Conclusion

The analytical results above show:

1. The results of using the rocket tube shock method to measure the rigidity of the rubber on the load-bearing wheel rim of the tank and the damping coefficient are reliable, and the method is simple, easy, and feasible.

2. When the sudden release method is used to identify the parameters of the suspension system of the tank, the tank with load-bearing wheels symmetrical about the center of gravity of the body of the vehicle can be suitably simplified to a mathematical model of vertical vibration. Tanks with load-bearing wheels asymmetrical to the center of gravity of the vehicle can be simplified to a mathematical model of a joint pitching-vertical vibration.

3. If we use the equivalent rigidity coefficient $k_{eq} = 5.25 \times 10^4$ (kilometers/meter) known for each spring of the tested tank as the rigidity coefficient of the springs of that tank, and take into consideration the identified results of the model of joint pitching-vertical vibration affected by the rigidity coefficient k_0 of the damper, then the rigidity coefficient of the damper $k_0 = 2.4368 \times 10^4$ (kilograms/meter) and the damping coefficient $c = 4.57 \times 10^3$ (kilograms•second/meter) are closer to the actual situation.

4. Because the effect of the tension of the track was neglected in establishing the mathematical model, the estimated value of k_0 may be too high. In addition, the rigidity of the oil damper and the damping coefficient should be functions[7] of the frequency of the shock force, while the results of this article are only the values for low frequencies. Therefore, further studies are required.

V. Appreciation

This experiment was completed with the help of comrades Jiang Jinren [3068 6602 0088], Zhou Shijun [0719 0013 7486], and Lu Qinnian [7120 2953 1628] of the 201 Institute of the 5th Ministry of Machine Building and the Engineering Mechanics Institute of the Chinese Academy of Sciences. The writer thanks them.

Appendix

We conducted a simulated experiment to determine the rigidity of the rubber of the load-bearing wheel rim and the damping coefficient.

Four pieces of rubber 3 centimeters long, 3 centimeters wide, and 4 centimeters thick were cut off from the rubber of the load-bearing wheel rim of a tank. They were symmetrically placed to support a steel plate [weighing] 500 kilograms, as shown in Figure 1, so that the pressure borne by the pieces of rubber were approximately equal to the pressure received by the rubber of the load-bearing wheel rim on the tank.

A hammer was used to strike the steel plate and initiate free attenuating vibration in the steel plate. The measures ω_0 and ζ were substituted into the following formulas

$$K_{modulus} = \omega_0{}^2 M_{modulus} = 2.47075 \times 10^5 \text{ (kilograms/meter)}$$

$$C_{modulus} = 2\zeta\omega_0 M_{modulus} = 5.68 \times 10^2 \text{ (kilograms•second/meter)}$$

Therefore, the rigidity and damping coefficient per unit area of the wheel rim rubber are

$$K_S = \frac{K_{modulus}}{S_{modulus}} = 6.863 \times 10^3 \text{ (kilograms/meter•square centimeter)}$$

$$C_S = \frac{C_{modulus}}{S_{modulus}} = 15.778 \text{ (kilograms•second/meter•square centimeters)}$$

The $S_{modulus}$ here is the sum of the sectional areas of the four pieces of rubber. The sum of the areas of contact between the load-bearing wheel rim rubber and the track of that tank is

$$S = (2xdxL) \times 10 \text{ (square centimeters)}$$

where d = 16.3 (centimeters) is the width of the single load-bearing wheel, and L is the length of contact between the load-bearing wheel rim rubber and the track; see accompanying Figure 2. If L = 3 to 5 centimeters, then the total rigidity and damping coefficient of the load-bearing wheel rim rubber of that tank are

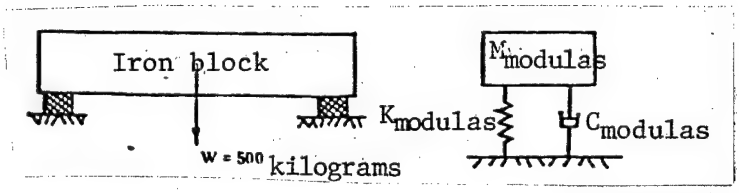

Figure 1

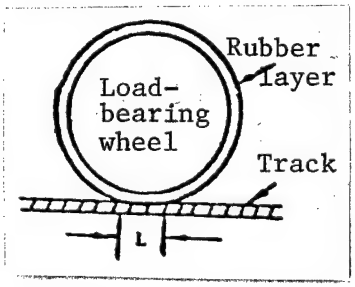

Figure 2

$$K_{rubber} = k_5 \cdot S = 6.7122 \times 10^6 \sim 1.1187 \times 10^7 \text{ (kilogram/meter)}$$

$$C_{rubber} = c_5 \cdot S = 1.5433 \times 10^4 \sim 2.5721 \times 10^4 \text{ (kilogram•second/meter)}$$

(This article was received on 12 July 1982)

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9296
CSO: 4008/57

BRIEFS

HIGH PERFORMANCE LSI CIRCUITS--China's first generation of high-performance large-scale integrated circuits was born in Yongchuan on 25 March 1983. A concerned expert said that this indicates China's S/T personnel have mastered the advanced techniques in this area, and this will effectively propel the development of high-speed computers in China. This major success in research was achieved by the Sichuan Solid State Circuits Institute by breaking through the barrier of the three short channel technology. They have also broken through the bipolar isoplanar technology and successfully built ultra high speed digital integrated circuits sorely needed by giant-sized computers and the national defense modernization program. The Evaluation Committee of the Ministry of Electronics is of the opinion that these fruitful results can be immediately put into trial production in the plants. [Text] [Beijing GUANGMING RIBAO in Chinese 27 Mar 83 p 1]

HIGH POWER LASER--A 2,000 watt high power laser sorely needed by China's machine-building industry has been successfully manufactured in Shenyang recently. This laser cuts a piece of hard alloy steel 10-odd milimeters in thickness like it is cutting a piece of paper. Its cutting speed is 8 times greater than the traditional cutting method widely employed throughout the country. [Text] [Harbin HEILONGJING RIBAO in Chinese 13 Mar 83 p 4]

CSO: 4008/94

AUTHOR: KE Cha [2688 2686]
ZHAI Ruikai [5049 3843 0418]

ORG: Both of Xinjiang Construction Machinery Plant

TITLE: "Automatic Welder XSH-120 for Welding Two Reinforcing Steels"

SOURCE: Beijing JIANZHU JIXIE [CONSTRUCTION MACHINERY] in Chinese No 2, 28 Mar 83 pp 49-50

ABSTRACT: The XSH-120 automatic welder for welding 2 reinforcing steel wires, designed by Xinjiang Research Institute of Construction Sciences and experimentally made by Xinjiang Construction Machinery Plant has been tested to meet the design requirements. On the basis of summarizing the test results, the 2 prototypes will be revised partially and undergo continued testing. The success of the research project will create the condition for extending double-wire reinforced concrete members in Xinjiang. The automatic welder will welder two vertical and horizontal steel wires of a given interval in the same plane to form blocks. The machine feeds the materials, straightens them, cuts them, welds them, and counts the numbers automatically. A cam structure distributes the welding time and a photoelectric trigger silicon controlled system controls the current. The optimal welding parameter may be conveniently selected. There is also a relatively perfect water cooling system to provide a good heat dispersion condition. The major parameters and properties of the XSH-120 are briefly described. The cost of making a prototype is too high, however; further improvement is needed.

6168
CSO: 4009/146

AUTHOR: LU Dingyi [7627 1353 0001]

ORG: None

TITLE: "The Third Annual Conference of Jiangsu Provincial Branch of Heat Treatment Society"

SOURCE: Beijing JINSHU RECHULI [HEAT TREATMENT OF METALS] in Chinese No 3, 25 Mar 83 p 23

ABSTRACT: The Third Annual Conference and Experience Exchange Meeting of the Jiangsu Provincial Branch of Heat Treatment Society were held from 27 Nov to 1 Dec 82. The spirit of the Third National Heat Treatment Technology Exchange Conference was conveyed and 32 papers were delivered to exchange results of research and application in the aspects of basic theories, new work processes, materials, techniques, and equipment. The work of the previous session of the society was summarized and a new board of directors elected. The activity plan for 1983 was formulated. Through discussion, it was also resolved that the Heat Treatment Technology Experience Exchange Conference of the Machine System of East China Region will be held in Jiangsu during the 4th quarter of this year.

6248
CSO: 4009/144

AUTHOR: None

ORG: None

TITLE: "Second Congress of Representatives of China Society of Instruments and Meters Held"

SOURCE: Beijing YIQI YU WEILAI [INSTRUMENTATION AND FUTURE] in Chinese No 2, Feb 83 p 32

ABSTRACT: On 24-28 Dec 82, China Society of Instruments and Meters called its second Congress of Representatives and nearly 400 scientists of the field attended. ZHOU Peiyuan [0719 1014 3293], Chairman of China Science Association, SHEN Hong [3088 7703] a counsel of Ministry of Machine Industry, etc. arrived to deliver opening speeches. Many of the 80 papers exchanged reflected achievements of recent years and a large number of them produced direct economic value. The congress was divided into groups to discuss such special subjects as classification, foreign and domestic developmental trends, reliability, etc. of instruments and meters. The work of the society of the past 3 years since its establishment was summarized. A second Board of Directors, consisting of 99 regular members and 23 standing members, was elected, with WANG Dezhao [3076 1795 2507] serving as its chairman.

6168
CSO: 4009/151

AUTHOR: XIAO Mu [5135 2606]

ORG: None

TITLE: "Water-mixed Fuel and Combustion Science Conference Held in Tunqi City of Anhui Province"

SOURCE: Tianjin XIAOXING NEIRANJI [SMALL-SIZE INTERNAL COMBUSTION ENGINES] in Chinese No 1, 25 Mar 83 p 25

ABSTRACT: The Water-mixed Fuel and Combustion Science Conference, sponsored by China University of Science and Technology, was held in Tunqi City on 26 Sep 82 and attended by more than 40 persons, representing scientific research academies and institutes, universities, factories, and transportation and navigation organizations. The 30+ papers delivered at the conference involved the processes of preparing water-mixed fuels, the equipment used, the fuel characteristics, the combustion mechanism, the composition and analysis of discharged substance, its testing and application, and international information on the subject. Although there have been rise and fall, here and abroad, with respect to research and application of water-mixed fuel, its merits of low polluting, energy saving, and safety are generally acknowledged in the world today. In China, its research began rather early but the interest in it has fluctuated a great deal. Those who have persisted have produced results [not specified in the paper, however.] In the future, scientific caution should be stressed; its necessary unified standards should be formulated; and the relationship of its research, experimentation, and extension should be properly handled. With the above, all delegates agreed unanimously. They also unanimously requested that proposals should be brought to related leadership departments through all types of channels to obtain guidance and support to strengthen the work of research, application, and extension of water-mixed fuel.

AUTHOR: XIAO Mu [5135 2606]

ORG: None

TITLE: "Three Specialty Committees of China Society of Internal Combustion Engines Held Joint Symposium"

SOURCE: Tianjin XIAOXING NEIRANJI [SMALL-SIZE INTERNAL COMBUSION ENGINES] in Chinese No 1, 25 Mar 83 p 78

ABSTRACT: The Combustion, Energy Conservation, and Purification Specialty Committee, the Intermediate and Small Diesel Engine Specialty Committee, the Gas-powered and Gasoline Engines Specialty Committee, and the Hubei Provincial and Wuhan Municipal Internal Combustion Engines Societies of China Society of Internal Combustion Engines held a joint symposium in Shiyan City of Hubei Province on 27 Oct - 1 Nov 82 and 216 delegates attended. A total of 69 papers were delivered concerning such subjects as the principle of heat release, energy conservation, substitute fuels, design techniques of diesel engines, auxiliary systems, reliability of the engine, etc. It was made clear at the symposium that the problem of energy conservation has been given serious attention. Designing of diesel engines has progressed from experience designing to theoretical designing on the basis of experimental research. Breakthroughs are still needed regarding some key techniques, however. Capabilities of many fields should be organized to pursue them.

6168
CSO: 4009/149

AUTHOR: CAO Weiqian [2580 4850 0051]

ORG: None

TITLE: "General Rules of Precision Inspection of Metal Cutting Machine Tools Became Effective on 1 Jan 83"

SOURCE: Dalian ZUHE JICHUANG [MODULAR MACHINE TOOL] in Chinese No 3, 25 Mar 83 p 13

ABSTRACT: The JB2670-82 General Rules of Precision Inspection of Metal Cutting Machine Tools, issued by the Ministry of Machine Industry on 28 Sep 82, are the equivalent of the international standard ISO/R230-1961. The document, JB2670-82, was to become effective on 1 Jan 83 and to form the basis for enacting and implementing the precision standards of all types of machine tools and modular machine tools. The precision standards previously formulated by Research Institute of Modular Machine Tools for general parts, machine tools, and automated lines may conflict with the new document and revision and reenactment may be necessary. In order to promote its understanding and resolve problems arising from the adoption of international standards, the Bureau of Machine Tools, Ministry of Machine Industry organized a course in Miyun of Beijing to run from 30 Nov to 11 Dec 82. At the conclusion of the course, all units were required by the bureau to launch positively the work of propagandizing and implementing the new standard. Chief Engineer MA Tingsheng [7456 1694 5116] of the bureau discussed some problems in adopting the international standard before the class.

6168
CSO: 4009/147

AUTHOR: LI Qi [2621 3825]
YANG Qiuhong [2799 4428 5725]

ORG: Both of Photometry Office, China Research Academy of Metrology

TITLE: "Properties of Luminous Intensity Standard Lamp Made in China"

SOURCE: Beijing JILIANG JISHU [MEASUREMENT TECHNIQUE] in Chinese No 2, 18 Mar 83 pp 39-43

ABSTRACT: The BDQ globular incandescent tungsten filament lamp was produced in China in 1974 to serve as a luminous intensity standard lamp. In order to make better use of this type of lamps to raise the precision of measurement, its properties must first be understood. Experiments were carried out by the authors to determine: (1) Distribution of luminous intensity in the horizontal and vertical directions; (2) Incandescent lamp specific indices; (3) Deviation from the law of inverse proportion to the square of distance; (4) Effects of forms of ignition and time on luminosity. Results of the experiments demonstrate that the lamp is satisfactory except for the fact that the light reflection of the stand and the core stick is too great. This defect is in need of improvement.

AUTHOR: None

ORG: None

TITLE: "Certification Conference Approved the Compound, Large, Automatic Distribution Photometer and Its Use as the Secondary Standard for Verifying the Total Luminous Flux of 2353K and 2788K Lamps"

SOURCE: Beijing JILIANG JISHU [MEASUREMENT TECHNIQUE] in Chinese No 2, 18 Mar 83 inside back cover

ABSTRACT: On the basis of a predecessor made in Fudan University in 1979, the compound large automatic distribution photometer has been made as the fruit of joint research by China Research Academy of Metrology and Fudan University. It is designed for both collinear and reflection measurement. Many anti-interference measures are adopted in its drive and control circuits to guarantee stable operation. In collinear measurement, the stray light is less than 0.06 percent; in reflection measurement, less than 1 percent. Prolonged experimentation indicates its relative standard deviation σ to be less than $\pm$0.2 percent. The difference between results of collinear and reflection measurements is less than 0.3 percent. The uncertainty of luminous flux measurement derived from a luminosity unit using this photometer is $\pm$0.42 percent for the 2353K lamp group and $\pm$0.48 percent for the 2788K lamp group, not including the uncertainty of the luminosity unit itself. Its credibility probability is close to 1. It has been approved by a certification conference held in Nov 82.

AUTHOR: JIANG Changgui [5592 2490 2710]
YIN Yanzi [1438 3348 1311]

ORG: None

TITLE: "Near Infrared Spectrum Absolute Diffuse Reflection Ratio Standard"

SOURCE: Beijing JILIANG JISHU [MEASUREMENT TECHNIQUE] in Chinese No 2, 18 Mar 83 inside back cover

ABSTRACT: China Research Academy of Metrology has established the absolute diffuse reflection ratio standard of the spectral range of 800-2000nm. The major technical indices of the standard experimental installation and the standard reflection board are as follows: Repeatability is within ±0.004; reappearance ±0.010; within the range of 800-1850 the compound measurement uncertainty is ±0.006, within the range of 1850-2000 ± 0.020. For the first time, polytetrafluoroethylene was used as the material in China to make the work standard board successfully. This standard was officially certified and approved on 25 Nov 82. The standard may be used to rectify laboratory spectroscopes and to check the reflection board.

6168
CSO: 4009/142

AUTHOR: WEI Zhonglei [7614 0022 4320]
XU Huiji [6079 1979 1569]

ORG: None

TITLE: "First National Symposium on Turbulent Flow, Boundary Layer, and Flow Stability Held in Wuhan"

SOURCE: Beijing LIXUE YU SHIJIAN [MECHANICS AND PRACTICE] in Chinese No 2, Feb 83 p 6

ABSTRACT: The First National Symposium on Turbulent Flow, Boundary Layer, and Flow Stability, sponsored by China Society of Mechanics, was held in Wuhan on 25-29 Oct 82 and attended by 68 delegates of 42 related research agencies, universities, and national defense departments all over the country. Prof. ZHOU Peiyuan [0719 1014 3293] came to report on the research of turbulent flow theory. A total of 43 scientific papers were exchanged and some delegates also introduced the conditions of research on turbulent flow in England, the USA, Japan, etc. Contents of the papers involved the basic theory of turbulent flow and flow stability, the quasi-sequential structure of mixed layer and boundary layer, characteristics of overflow boundary layer, analysis and calculation of boundary layer, efflux noise, and boundary layer flow of the atmosphere, ships, open ditch water, and fluid in pipes, etc. Some results of turbulent flow boundary layer have been applied in production. Among the authors of these papers and participants of the symposium, 89 percent are middle-aged scientists; the average age of all the delegates was 44 years.

AUTHOR: JIN He [6855 0735]
DAI Shiqiang [2071 0013 1730]

ORG: None

TITLE: "National Symposium of Nonlinear Mechanics"

SOURCE: Beijing LIXUE YU SHIJIAN [MECHANICS AND PRACTICE] in Chinese No 2, Feb 83 pp 14, 34

ABSTRACT: The National Symposium on Nonlinear Mechanics, under the auspices of the Rational Mechanics and Mathematical Methods in Mechanics Specialty Group China Society of Mechanics, was held in Wuxi, Jiangsu Province. Lanzhou University took charge of organizing the symposium and Prof Ye Kaiyuan [0673 7030 3104] chaired the meetings. During the opening ceremony, Prof QIAN Weichang [6929 0251 7022] provided an outline of the history of development of nonlinear mechanics and pointed out that at present the major trend of development of mechanics will continuously be in that direction. He gave a large quantity of facts in modern industrial production to explain that many actual problems of engineering cannot be resolved with linear theory. The contents of the papers presented at the symposium included elastoplastic dynamics, nonlinear fluctuation and stability in fluids, atmospheric dynamics, cosmogony, variational method and finite element, nonlinear vibration, etc.

AUTHOR: JIN He [6855 0735]

ORG: None

TITLE: "Third National Symposium on Reactor Structure Mechanics was Held in Beijing"

SOURCE: Beijing LIXUE YU SHIJIAN [MECHANICS AND PRACTICE] in Chinese No 2, Feb 83 p 19

ABSTRACT: The Third National Symposium on Reactor Structure Mechanics was held on 11-16 Oct 82 in Beijing. It was sponsored by China Society of Mechanics and the Reactor Structure Mechanics Specialty Group of China Society of Nuclear Science. A total of 45 papers were received and 58 delegates participated in the meetings. Prof TENG Deng [3326 5671], Vice president of Qinghua University and Prof LYU Yingzhong [0712 2019 0022] attended the opening ceremony. Chief Engineer LIAN Peisheng [6647 1014 3932] of Bureau of Nuclear Power, Ministry of Nuclear Industry reported on the developmental situation of nuclear energy and proposed tasks of study on reactor structure mechanics. Prof HUANG Kezhi [7806 0344 2534] reported on the development of fracture mechanics; Prof HU Haichang [5170 3189 2490] reported on problems in the development of structure dynamics. Based upon the contents of the papers submitted, the discussions proceeded in the 3 categories of heat and stress analysis, structure analysis, and structure dynamics. Delegates agreed that compared with previous symposium, the papers have improved in depth and breadth, especially with respect to nonlinear analysis and structure dynamic analysis of structures. It was resolved tentatively that the 4th symposium will meet in 1984-85.

AUTHOR: None

ORG: None

TITLE: "Report of the Conference to Establish of Science Popularization Work Committee of China Society of Mechanics"

SOURCE: Beijing LIXUE YU SHIJIAN [MECHANICS AND PRACTICE] in Chinese No 2, Feb 83 pp 52-53

ABSTRACT: For the purpose of making the knowledge of mechanics a weapon in the hands of the masses, the society's standing board of directors resolved to establish the Science Popularization Work Committee.A Conference for its establishment was held on 28-30 Oct 82 in Wuxi of Jiangsu Province and more than 60 persons attended. Aside from establishing the committee, the major tasks of the conference also included exchanging the experiences of popularizing the knowledge of mechanics and discussing the 1983 work plan and a 5-year work schedule. Delegates agreed that the work should be divided into: (1) High level popularization with college graduates as the targets; (2) Middle level popularization with graduates of middle and specialty schools as the targets; (3) For all other readers and youths.

6248
CSO: 4009/140

AUTHOR: XING Weizhong [1630 0251 0022]
XU Jianben [1776 1696 2609]

ORG: Both of the Beijing Mining and Metallurgical Research Institute

TITLE: "Investigation of New Method of Magnetic Seeding for Concentration of Dong'anshan Hematite Ore"

SOURCE: Beijing JINSHU XUEBAO [ACTA METALLURGICA SINICA] in Chinese No 1, 1983 pp B1-B11

TEXT OF ENGLISH ABSTRACT: An attempt was made to develop the new method of magnetic seeding for concentration of Dong'anshan hematite ore, in which the influence of such factors as magnetic seed dose rate, stirring time, dose rate and proportion of collector-agglomerant, density and speed of repulping pulp conditioning, quality of water, pH of medium, etc., has been systematically investigated and discussed. It was shown that the vigorous stirring and high density contribute to the agglomeration magnetic seeding process. A diagramatic flowsheet illustrating the separation process by magnetic seeding and its classification was established. A concentration grade of 66.85 percent Fe and recovery of 99.02 percent as well as waste tailing of 0.67 percent Fe were obtained by using this new method from a synthetic mineral mixture of hematite

[Continuation of JINSHU XUEBAO No 1, 1983 pp B1-B11]

and quartz (1:1). In addition, concentrates containing 53.1 percent Fe and recovery of 95.3 percent were yielded from Dong'anshan crude ore assaying 32 percent Fe. These results have been verified by the tests of the same procedure for Sijiayin hematite ore. Preliminary industrial practice seems to prove that the separation process utilizing the magnetic seeding is a potential possibility for concentration of Dong'anshan hematite and other similar ores.

9717
CSO: 4009/141

AUTHOR: WU Tongwei [3527 4827 0251]

ORG: Maanshan Iron and Steel Design Institute

TITLE: "Energy Saving Approaches and Direction in Chinese Rolling Mills"

SOURCE: Beijing GANGTIE [IRON AND STEEL] in Chinese No 1, Jan 83 pp 63-69

ABSTRACT: Efforts have been exerted in Chinese steel rolling mills to improve the technical training of the workers and to reconstruct furnaces in order to reduce energy consumption. In the 3 years of 1978-81, the rate has come down from 0.85 x 10^6Kcal/t to 0.61 x 10^6Kcal/t but it is still 2-3 times that of Japan. The author believes that in view of the actual conditions in China, further reduction of energy consumption depends on the following: (1) Quantitative management and periodical equipment inspection and repair system must be introduced; (2) Reducing the starting temperature and finishing the rolling process in one operation; (3) Shortening the heat treatment duration; (4) Gradually and rationally merging and consolidating existing small mills. The paper includes tables comparing the unit energy consumption in Chinese mills with that of mills in Japan and other countries of the world and the energy consumption of 6 different production techniques of rolled steel.

AUTHOR: ZHANG Huitang [1728 1920 2768]

ORG: None

TITLE: "The Third Iron Alloy Symposium"

SOURCE: Beijing GANGTIE [IRON AND STEEL] in Chinese No 1, Jan 83 pp 76-77

ABSTRACT: The Third Iron Alloy Symposium of the Iron Alloy Committee China Society of Metals and the 4th Technical Experience Exchange Meeting of the Iron Alloy Information Network Ministry of Metallury were held jointly on 20-27 Aug 82 in Northwest Iron Alloy Plant of Lanzhou and attended by 114 delegates. Of the 64 papers received, 27 were read. Discussions involved summarization of energy conservation efforts in iron alloy industries in China in recent years, environmental protection measures, customer services, and improvement of economic benefits. The energy saving effects of using coal gas tar as the reduction agent in silicon iron productian have been proved to be very obvious. After the adoption of low carbon chromium iron work process in oxygen converter, the power consumption has been 2000KWh/t less. A scheme to expand the Northwest Iron Alloy Plant was proposed and many beneficial opinions were received from the delegates. It was resolved that a symposium of iron alloy technology, economics, and product quality will be held in May 83 in Jiujiang City of Jiangxi Province.

AUTHOR: WU Chongyuan [0702 1504 3293]

ORG: None

TITLE: "Fourth Symposium on Low Temperature Steels"

SOURCE: Beijing GANGTIE [IRON AND STEEL] in Chinese No 1, Jan 83 p 77

ABSTRACT: The 4th Symposium on Low Temperature Steels, sponsored jointly by the Metallurgical New Materials Group of State's Science Committee and the Special Steels Committee of China Society of Metals was held in Liuzhou of Guangxi Province on 6-10 Oct 82. Participants included 51 delegates of 31 units and more than 20 papers were received. Contents of the papers involved basic theoretical research on the applications of low temperature steels, materials and property testing, and new results of researches on types of steels, etc. reflecting new advancements in low temperature property research of manganese-substituted nickel steel, research on the physical properties of low temperature steels, austenite and low temperature toughness of 9% Ni Steel, iron-based martensite phase and its application, superconduction material used in liquid helium temperature, superlow temperature, nonmagnetic stainless steels, Cr13Ni9Mn9N, 30Mn20Al3, and $30Mn23Al_{14}Cr_5$ systems. In order to gain an overall understanding of the condition of application of low temperature steels in China, the symposium decided to dispatch a specialty group next spring to visit the users and to write a report on the basis of the survey for the reference of related departments in order to promote the extension of low temperature steels made in China among the various departments of the national economy.

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CSO: 4009/148

AUTHOR: WU Yankang [0702 1693 1660]
ZHAO Rongjiu [6392 2837 3773]

ORG: Both of Beijing Central Research Academy of Iron and Steel Designing

TITLE: "A Study on the Enlargement of Existing Small Converters in China"

SOURCE: Beijing GANGTIE [IRON AND STEEL] in Chinese No 2, Feb 83 pp 15-20

ABSTRACT: The capacity of the majority of converters in China is small, mostly under 30 t. Whether or not the capacity of existing converters may be enlarged depends firstly on the possibility of increasing the size of the casing. Following an analysis of existing converters, the paper proposes the technique of modifying the trunnion ring in order to make use of the space beneath the furnace and to consider the possibility of making use of the potential of the tilting equipment. The paper concludes that it is feasible to change the existing 6t, 15t, and 30t converters into 10t, 25t, and 40t respectively. The investment will be reasonable and it is especially practical to change the 15t converters into 25t converters.

AUTHOR: GAO Yiping [7559 0001 1627]

ORG: None

TITLE: "Third National Symposium on Powder Metallurgy Held in Anshan"

SOURCE: Beijing GANGTIE [IRON AND STEEL] in Chinese No 2, Feb 83 pp 76-77

ABSTRACT: The 3rd Symposium of Powder Metallurgy of China Society of Metals was held in Anshan of Liaoning Province on 13-17 Oct 82. A total of 139 specialists, scientists, and engineers representing 81 related departments, research academies and institutes, production and designing units, and universities of 25 provinces, cities, and autonomous regions came to attend it. In his opening speech, Prof HUANG Peiyun [7806 1014 0061], Deputy Chairman of the Board of Directors of the society reviewed the conditions of production, research, and application of metal powders since the symposiums held in Qinhuangdao in 1978 and in Jinjiang in 1980. Presently, the productinn of iron powder is gradually recovering from the low ebb and good results have been obtained in its secondary reduction process, its equipment and research, and its application in production. The State's draft standard was discussed. Angang Comprehensive Utilization Company also presented an exhibit of powder metallurgy technology. It was resolved that the 4th national symposium on powder metallurgy will be held in the autumn of 1984 in Chengdu of Sichuan Province.

AUTHOR: None

ORG: None

TITLE: "Symposium on Atomic Absorption Spectrum"

SOURCE: Beijing GANGTIE [IRON AND STEEL] in Chinese No 2, Feb 83 p 78

ABSTRACT: A Symposium on Atamic Absorption Spectrum, sponsored jointly by Physical and Chemical Inspection Technology Committee China Society of Metals and the Analysis Information Network of Ministry of Metallurgical Industry,was held in Hangzhou on 4-9 Nov 82 and attended by 188 delegates of 141 units. Atomic absorption spectrum is a newly developed effective technology of analysis and has been broadly applied in analyses of ores, raw materials, metallurgical products, and highly purified materials as well as environmental protection surveillance. Contents of the 153 papers received included flameless atomic absorption, flame atomic absorption, atomic absorption of hydrogenates and atomic fluorescence, various methods of isolation and concentration, improvement of instruments, methods of experimentation, digital processing, etc. Suggestions of delegates regarding the development of the technology included mainly (1) Continue to develop research on interference mechanism and to improve flame atomic absorption technique; (2) Develop flameless atomic absorption analysis, its research, and its application; (3) Extend the application of hydrogenate technique; (4) Improve the quality of China-made instruments as fast as possible; (5) Start the work of formulating standards of atomic absorption analysis.

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AUTHOR: XIAO Xidi [5135 4406 4272]

ORG: None

TITLE: "Discovery of Basaltic Komatites in Yiyang of Hunan Province"

SOURCE: Changsha ZHONGNAN KUANGYE XUEYUAN XUEBAO [JOURNAL OF CENTRAL-SOUTH INSTITUTE OF MINING AND METALLURGY] in Chinese No 1, Mar 83 p 37

ABSTRACT: In the metamorphosed basic volcanic rock system to the southwest of Yiyang City, Hunan, there are 2 layers of lava rocks in the form of rock flowage, with the pillow structure of typical underwater eruption. They are at the base of the sedimentary cycle, with the rock system of deep sea turbid deposits underneath. The lithochemical characteristics are very similar to the basaltic komatiites of South Africa and the USSR of Eastern Europe. The mean contents in percentage are: SiO_2 50.69, TiO_2 0.53, MgO 11.08, Na_2O 1.39, K_2O 0.3, P_2O_5 0.067, and high in Cr, Ni, and Au. The discovery of komatiites provides the explanation for the source of materials of such ores as gold in that region. The discovery has not only theoretical significance. It also has real economic value. Research work on it is proceeding in earnest.

AUTHOR: XIE Zongren [6200 1350 0088]
ZHU Guang [3608 0342]

ORG: None

TITLE: "Successful Development of New Non-clay Wellbore Fluids and an Apparatus for Flow Rate and Direction"

SOURCE: Changsha ZHONGNAN KUANGYE XUEYUAN XUEBAO [JOURNAL OF CENTRAL-SOUTH INSTITUTE OF MINING AND METALLURGY] in Chinese No 1, Mar 83 p 80

ABSTRACT: At present, domestic and foreign research units and geological prospecting departments are all highly concerned with the problem of protecting the wall and plugging the leaks of holes in complex strata bored with diamond drills. Most recently, 2 types of new non-clay Wellbore fluids, MY-1 and MY-1A, and the LSX-2 digital bore hole flow rate and direction instrument were successfully produced by the Prospecting Teaching and Research Office, Department of Geology of Zhongnan Institute. Practices have proved that when MY-1 and MY-1-A are used for rock core bore prospecting in water-sensitive strata and collapsable, broken, and instable strata, they can raise the drilling speed and provide good protection for the walls. The raw material is mainly polysaccharides, which are not toxic. With treatment, their viscosity may be adjusted in a wide range. They are highly calcium and salt resistant. A conference, under the auspices of Ministry of Metallury, has approved these new products . Their production is presently being organized.

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AUTHOR: ZHAO Bangti [6392 6721 1879]
XU Hongji [1776 3163 1015]
MA Shuyi [7456 2885 5030]
SHEN Tong [3088 0681]

ORG: All of Department of Biology

TITLE: "Preparation and Characterization of Mitochondrial DNA From the Liver of Beijing Duck"

SOURCE: Beijing BEIJING DAXUE XUEBAO--ZIRAN KEXUE BAN [ACTA SCIENTIARUM NATURALIUM --UNIVERSITATIS PEKINENSIS] in Chinese No 1, Feb 83 pp 72-78

ABSTRACT: This paper reports a convenient procedure to prepare mitochondrial DNA from Beijing Duck liver. Healthy female ducks, about 50 days old, supplied by the Yuanmingyuan Duck Farm of Beijing, were used for the experiment. Each liver weighed about 50 g. After extraction with 0.8 percent SDS and deproteinized with 1M $NaClO_4$ and chloroform, the macromolecular RNAs were removed with 2M NaCl; then, a Sepharose 4B gel column was used for purification. Properties of the mtDNA were identified by uv absorption, gel electrophoresis, chemical analysis, and electron microscopy. The mtDNA of duck liver was found to consist of circular DNA molecules, same as other high class animals, with the contour length of 63 open circular molecules measuring $5.2 \pm 0.20 \mu m$ and a mean molecular weight of 37 molecules of $16,660 \pm 350$ base pairs or $(10.7 \pm 0.22) \times 10^6$ daltons. The parameter of duck liver mtDNA was found to be slightly longer than that of mammals reported in literatures, but slightly shorter than that of amphibians. The measurement of duck liver mtDNA is very close or slightly greater than the data on men and mice recently reported by Sanger and Clayton.

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AUTHOR: HUANG Zhenfa [7806 2182 4099]

ORG: None

TITLE: "National Symposium of Optical Glass Technology Held in Xiamen"

SOURCE: Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese No 2, Mar 83 p 101

ABSTRACT: The National Symposium of Optical Glass Technology, organized by Optical Glass Specialty Committee Chinese Society of Silicates, was held in Xiamen on 12-15 Nov 82. Close to 60 persons, representing major research organizations of optical glasses, colleges, and manufacturers, participated. The symposium received outlines of 40 papers and 31 of these were exchanged. The major contents included: optical glass smelting techniques, optical glass annealing techniques, research on quality improvement of optical glasses, optical glass systems, and research on types of optical glasses. These papers truly reflect the progress in China in the technology of making optical glasses.

AUTHOR: ZHANG Sansan [1728 3790 3790]

ORG: None

TITLE: "Fifth National Infrared Science and Technology Exchange Symposium Held in Wuhan City"

SOURCE: Shanghai GUANGXUE XUEBAO [ACTA OPITCA SINICA] in Chinese No 2, Mar 83 p 112

ABSTRACT: The Fifth National Infrared Science and Technology Symposium, jointly sponsored by China Society of Optics and China Society of Electronics, was held in Wuhan of Hubei Province on 5-9 Oct 82, and attended by 200+ delegates of more than 70 units of scientific research, production, education, and application aspects of the field. Nearly 150 papers were received. The central theme of the symposium was infrared detectors and materials. Aside from comprehensive reports, the discussions were carried out on the following separate subjects: (1) The tertiary system detectors, emphasizing the 2 types of PbSnTe and HgCdTe materials, devices, and their property tests; (2) The binary system detectors, including the 2 types of PbS or PbSe and InSb devices; (3) Heat sensitive type detectors, all involving thermal release electrical materials and devices; (4) The CCD group included 15 reports. During the symposium period, a joint work conference was held by the Infrared Photoelectric Group of Division of Optics and Applied Optics of the State's Science Committee and the Infrared Photoelectric Devices Specialty Committee of China Society of Optics. It was resolved that the next National Infrared Technology Symposium will be held in 1984.

AUTHOR: YI Min [0044 3046]

ORG: None

TITLE: "The Second National Symposium on Some Fundamental Problems of Laser"

SOURCE: Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese No 2, Mar 83 pp 118,125, 145

ABSTRACT: The Second National Symposium on Some Fundamental Problems of Laser, sponsored by the Society of Optics, was held on 25-30 Oct 82 in Jiading County of Shanghai City. By the request of the Laser Specialty Committee China Society of Optics, this symposium was jointly organized by Shanghai Institute of Optical Machines and Fudan University, with Anhui Institute of Optical Machines, Anhui Institute of Physics, China University of Science and Technology, and Beijing University participating in its preparation. The 94 delegates came from 53 units of 18 provinces and cities all over the country. The discussions centered upon the following subjects: (1) Several fundamental concepts of nonlinear optics; (2) General problems of nonlinear optical phenomena; (3) The problem of coherent scattering; (4) Phase complex conjugate; (5) Nonlinear problem in laser spectrum, including the problem of excited Raman scattering [plasma]; (6) Other nonlinear problems. Ample time was provided at the symposium for debates and discussions and very satisfactory results were achieved.

AUTHOR: MA Xiaoshan [7456 4562 1472]

ORG: None

TITLE: "The Sixth National Conference on Crystal Growth and Materials"

SOURCE: Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese No 2, Mar 83 187

ABSTRACT: The Sixth National Conference on Crystal Growth and Materials, sponsored by China Society of Silicates, was held on 11-17 Oct 82 in Beijing and attended by 227 delegates. Nearly 300 papers were received; their abstracts were published in the Nos 2-3, 82 issue of RENGONG JINGTI, with contents involving laser and optical materials, nonlinear materials, piezoelectricity, acoustooptics, thermal release electricity, acoustic surface wave materials, ultrahard materials, x-ray spectral crystalline materials, etc. Judging from the products exhibited at the conference, the quality of crystals of practical uses, such as YAP, YAG, polycrystalline diamond, TeO_2, $PbMoO_4$, NdP_5O_{14}, etc. has improved in the past 3 years. There have also been breakthroughs of new crystals, such as $BeAl_2O_4:Cr^{3+}$, $MgF_2:Ni^{2+}$, $MgF_2:Co^{2+}$, $LiF:Mg^{2+}$, YLF, and the internationally first β-BaB_2O_4, etc. It was resolved that the Seventh National Conference will be held in the autumn of 1985 in Yantai City of Shandong Province.

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CSO: 4009/143

AUTHOR: CHEN Guangya [7115 0342 0068]

ORG: None

TITLE: "China Society of Systems Engineering Systems Theory Committee Held Its Second Scientific Conference"

SOURCE: Beijing XITONGGONGCHENG LILUN YU SHIJIAN [SYSTEMS ENGINEERING--THEORY AND PRACTICE] in Chinese No 1, Mar 83 p 19

ABSTRACT: China Society of Systems Engineering Systems Theory Committee held its second conference in Taiping County of Anhui Province on 14-20 Oct 82; 50 papers were received, involving such fields as engineering, economics, medicine, biology, social systems, etc. Domestic accomplishments in systems theory and systems engineering were exchanged. Some new ideas, new models, etc., both creative and practical, were proposed by some participants. The delegates agreed unanimously that systems theory should be established and developed on the basis of China's realities in order to contribute to the realization of 4 modernizations.

AUTHOR: ZHAO Jiguang [6392 4949 0342]

ORG: None

TITLE: "China Society of Systems Engineering Socioeconomic Systems Engineering Society Held Its Inaugural Meeting and a Symposium"

SOURCE: Beijing XITONGGONGCHENG LILUN YU SHIJIAN [SYSTEMS ENGINEERING--THEORY AND PRACTICE] in Chinese No 1, Mar 83 p 34

ABSTRACT: In Nanchang of Jiangxi Province, on 3-7 Dec 82, 106 delegates, coming from 19 provinces, cities, and autonomous regions, participated in the Inaugural Meeting and the symposium of the Socioeconomic Systems Engineering Society China Society of Systems Engineering. They included some scientists and economists of systems engineering work of long standing, such as Prof ZHANG Zhongjun [1728 6988 0193] of Shanghai Jiaotong University and LIU Yuanzhang [0491 3293 1728], a researcher of the Institute of Systems Science Chinese Academy of Sciences, as well as many young scholars of the field. The purpose of establishing the society, the realm of socioeconomic systems engineering, and ways for it to serve modernization construction were among the problems discussed. Following the election of members of the board of directors, the society was officially declared to be in existence. During the meeting, enthusiastic support was received from Jiangxi Provincial Committee, People's Government of Jiangxi Province, and other related authorities.

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AUTHOR: None

ORG: None

TITLE: "China Civil Engineering Society Tunnel Society Held a Seepage Prevention Technology Conference"

SOURCE: Chongqing DIXIA GONGCHENG [UNDERGROUND ENGINEERING] in Chinese No 2, 11 Feb 83 pp 33, 54

ABSTRACT: The First Technological Exchange Conference of the Water Seepage Prevention Group of China Civil Engineering Society was held in Guilin, Guangxi Province, on 15-20 Dec 82. Participants included 82 delegates representing various professions of 54 organizations; 38 papers were received. This conference was a combination of the Railway Tunnel League Treatment Experience Exchange Conference, originally planned by the Specialty Designing Academy of Ministry of Railways, and the technological certification conference for the technique of using iron sheets as sealing gaskets for water prevention, introduced by Shanghai Tunnel Construction Company. Aside from using cement, water glass, and polyaminoester as the slurry material, the railway system has also been extending positive ion emulsion asphalt. In newly designed tunnels, such as Dayaoshan and Nanling, polyethylene boards were used to form a barrier to prevent water seepage. The key to water prevention quality is, however, a system of technical training, management, and surveillance. There were also papers discussing methods and requirements for preventing freeze damage to tunnels in regions of severely cold weather.

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CSO: 4009/145

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